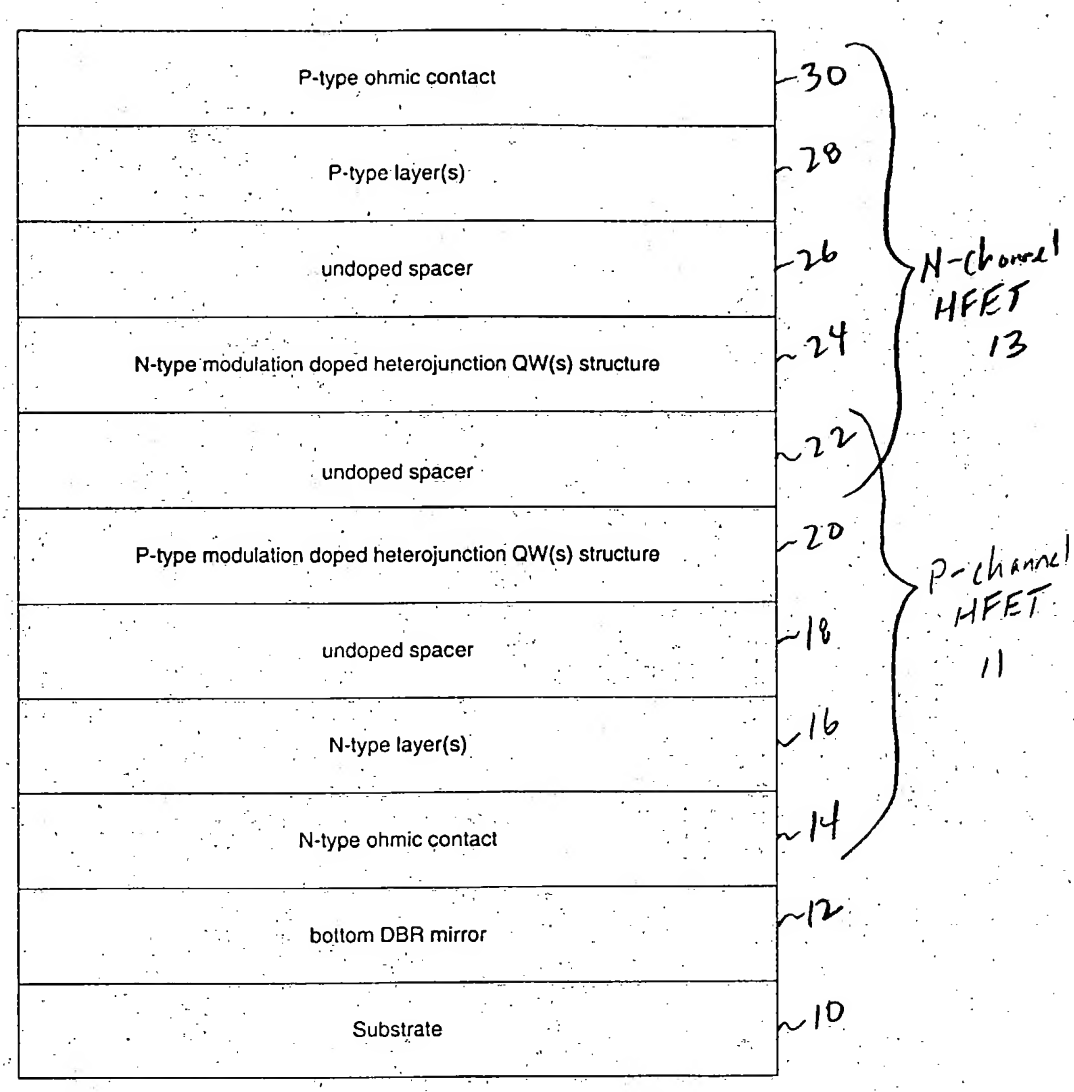

P-type ohmic contact
P-type layer(s)
undoped spacer
N-type modulation doped heterojunction QW(s) structure
undoped spacer
P-type modulation doped heterojunction QW(s) structure
undoped spacer
N-type layer(s)
N-type ohmic contact
bottom DBR mirror
Substrate
30
28
26
24
22
20
18
16
14
12
10
N-channel HFET 13
P-channel HFET 11

FIG. 1A

	Layer Material	Layer Doping Type	Typical Doping (atoms/cm3)	Typical Layer Thickness (A)	Layer #
30	InGaAs	P+	1E20	25	165b
28	GaAs	P+	1E20	75	165a
	Al(.7)Ga(.3)As	P	1E17	700	164b
	Al(.7)Ga(.3)As	P+	1E19	10	164a
	Al(.15)Ga(.85)As	P+	3.5E18	25	163d
26	Al(.15)Ga(.85)As		UD	300	163c
24	Al(.15)Ga(.85)As	N+	3.5E18	80	163b
	Al(.15)Ga(.85)As		UD	30	163a
	GaAs		UD	15	162
	In(.20)Ga(.80)AsN QW/ GaAs QW (x3)		UD	60	161
	GaAs Barrier		UD	100	160b
	GaAs		UD	150	160a
22	Al(.15)Ga(.85)As		UD	5000	159
20	GaAs Barrier		UD	100	158
	In(.20)Ga(.80)AsN QW/GaAs QW (x3)		UD	60	157
	GaAs		UD	15	156
	Al(.15)Ga(.85)As		UD	30	155d
	Al(.15)Ga(.85)As	P+	3.5E18	80	155c
18	Al(.15)Ga(.85)As		UD	300	155b
16	Al(.15)Ga(.85)As	N+	3.5E18	80	155a
	Al(.7)Ga(.3)As	N	1E17	700	154
14	GaAs	N+	3.5E18	2200	153
12	AlAs		UD	1701	151
	GaAs (x7)		UD	696	152
	AlAs		UD	1701	151
10	GaAs Substrate		SI		149

FIG. 1B

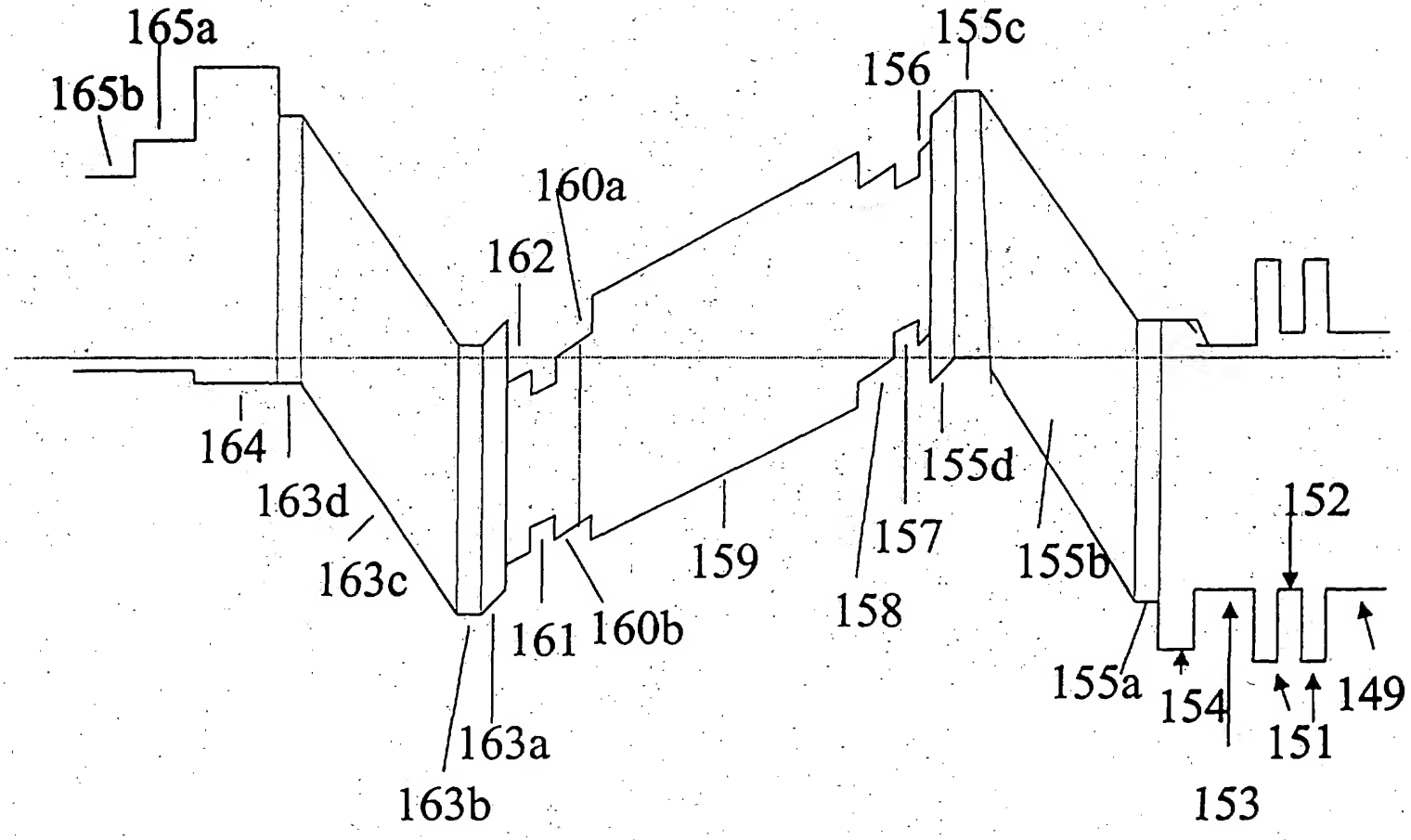

165a
165b
155c
156
160a
162
164
163d
163c
159
157
155d
152
158
155b
161
160b
155a
154
149
151
163a
163b
153

FIG. 1C

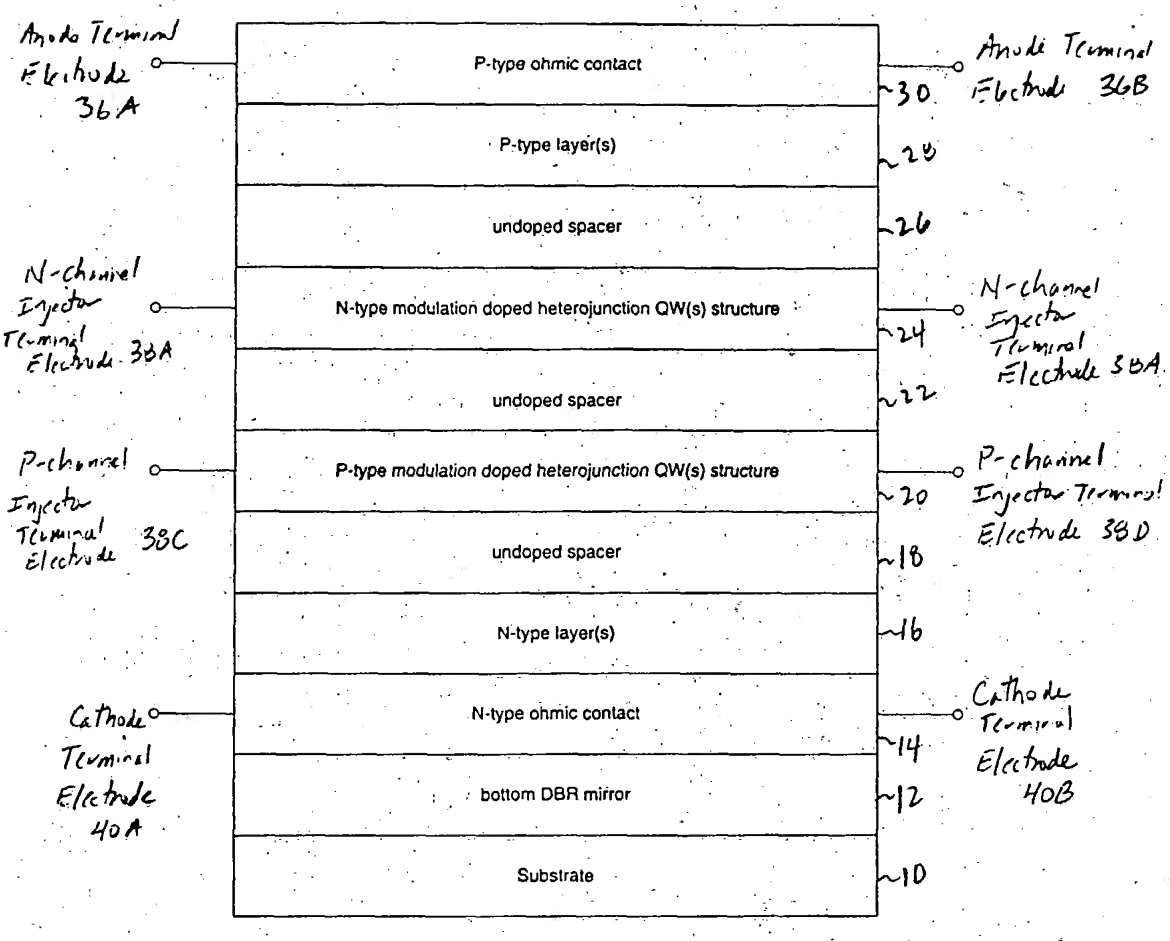

Anode Terminal Electrode 36A
P-type ohmic contact
30
Anode Terminal Electrode 36B
P-type layer(s)
28
undoped spacer
26
N-channel Injector Terminal Electrode 38A
N-type modulation doped heterojunction QW(s) structure
24
N-channel Injector Terminal Electrode 38A
undoped spacer
22
P-channel Injector Terminal Electrode 38C
P-type modulation doped heterojunction QW(s) structure
20
P-channel Injector Terminal Electrode 38D
undoped spacer
18
N-type layer(s)
16
Cathode Terminal Electrode 40A
N-type ohmic contact
14
Cathode Terminal Electrode 40B
bottom DBR mirror
12
Substrate
10

FIG. 2A

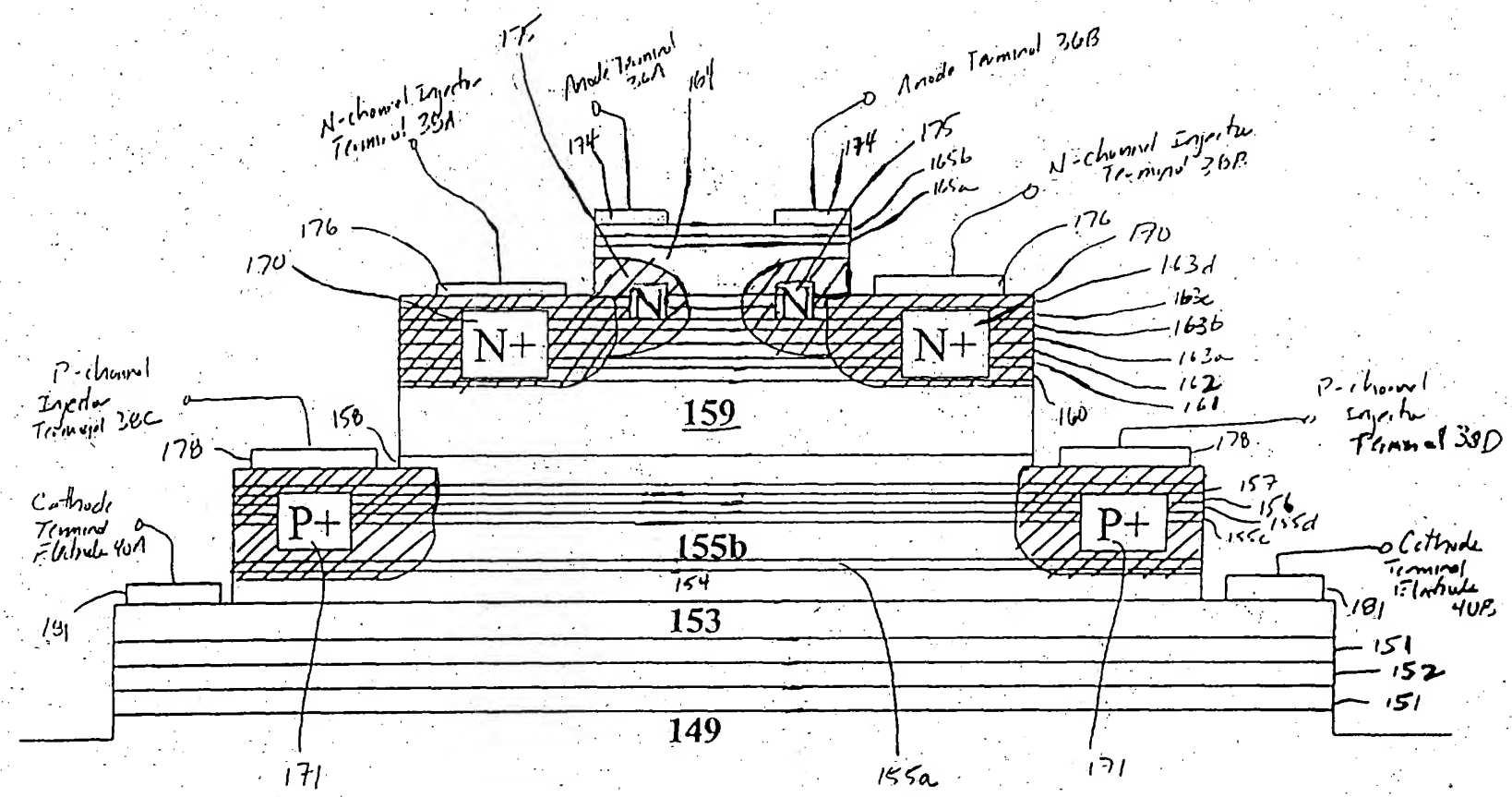

N-channel Injector Terminal 38A
Anode Terminal 36A
Anode Terminal 36B
N-channel Injector Terminal 38B
P-channel Injector Terminal 38C
P-channel Injector Terminal 38D
Cathode Terminal Electrode 40A
Cathode Terminal Electrode 40B
N+
N+
N
N
P+
P+
159
155b
154
153
149
151
152
151
171
155a
171
191
181
158
160
161
162
163a
163b
163d
165a
165b
170
174
175
176
178
157
155c
155d

FIG. 2B

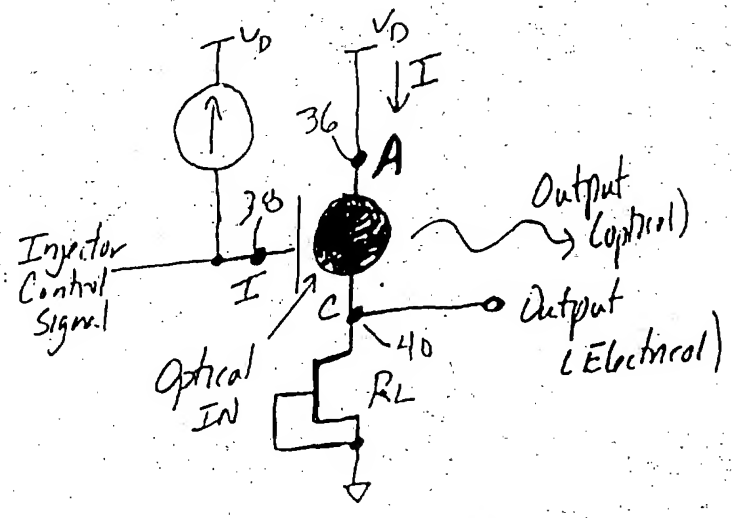

V_D
V_D
I
36
A
38
Output
(optical)
Injector
Control
Signal
I
C
Output
(Electrical)
40
Optical
IN
R_L

FIG 2C

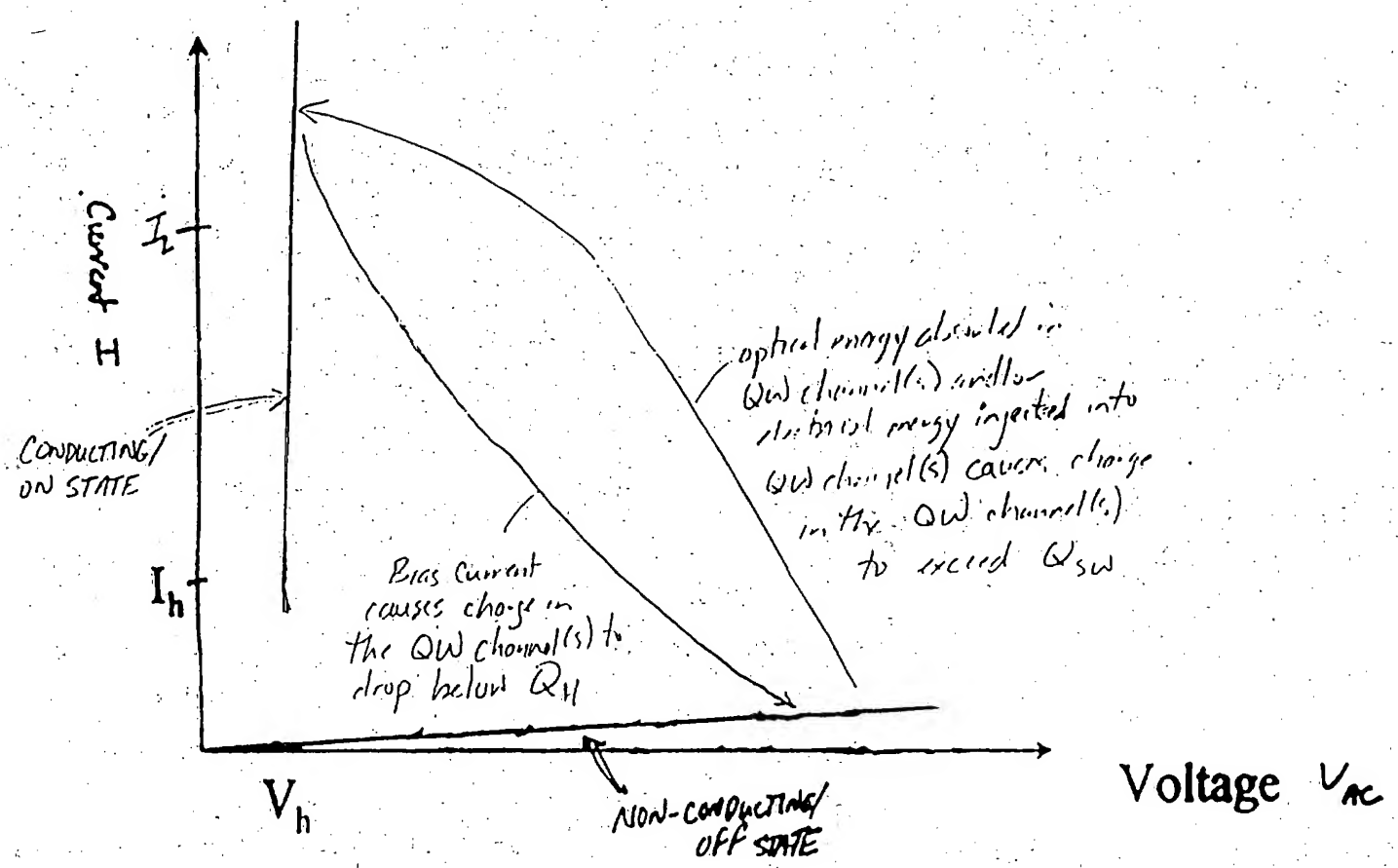

Current H
I_h
I_h
CONDUCTING/
ON STATE
optical energy absorbed in
QW channel(s) smaller
than optical energy injected into
QW channel(s) causes charge
in the QW channel(s)
to exceed Q_{SW}
Bias current
causes charge in
the QW channel(s) to
drop below Q_H
V_h
NON-CONDUCTING/
OFF STATE
Voltage V_{AC}

FIG. 2D

FIG. 3A1

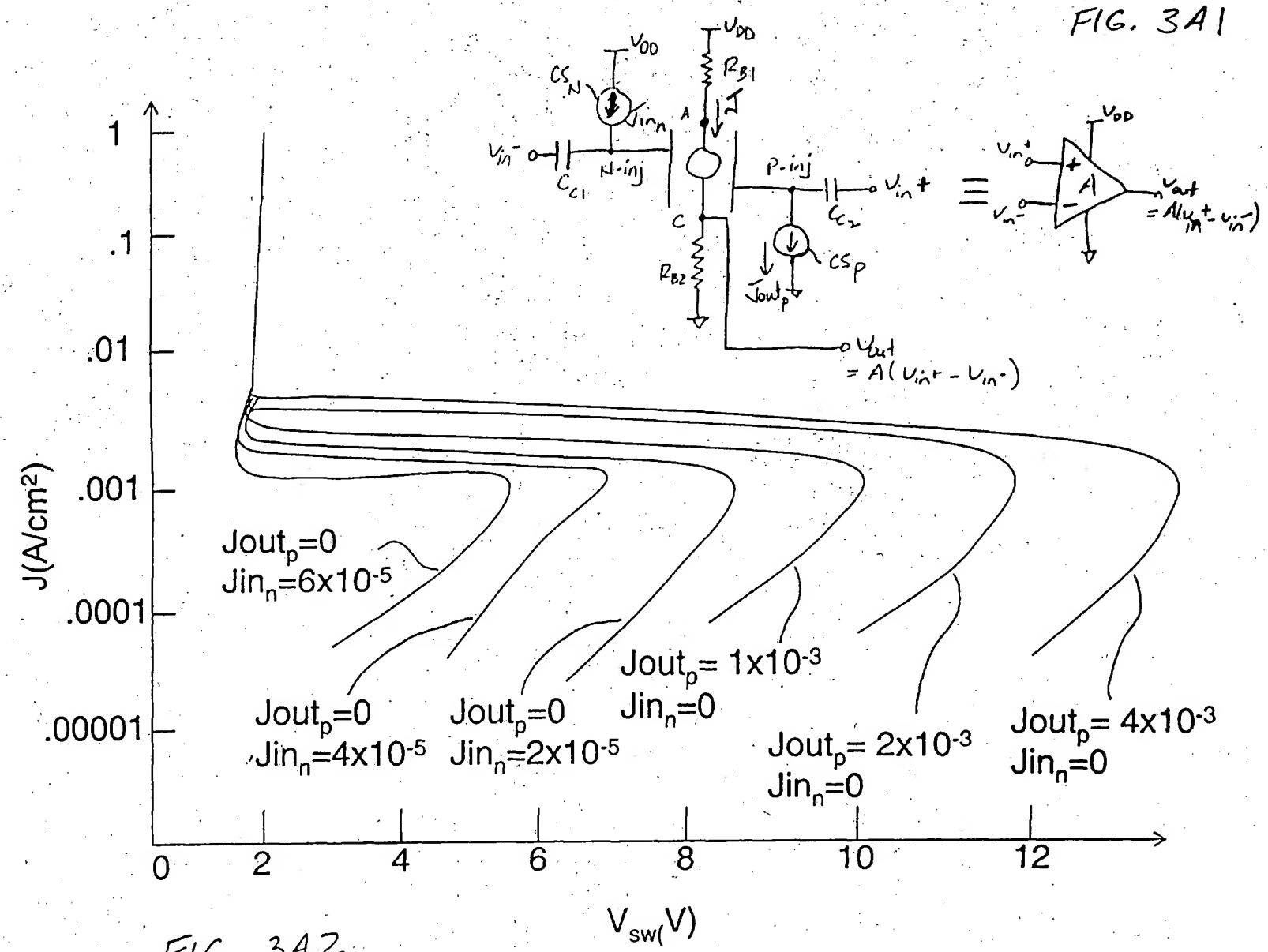


FIG. 3A2

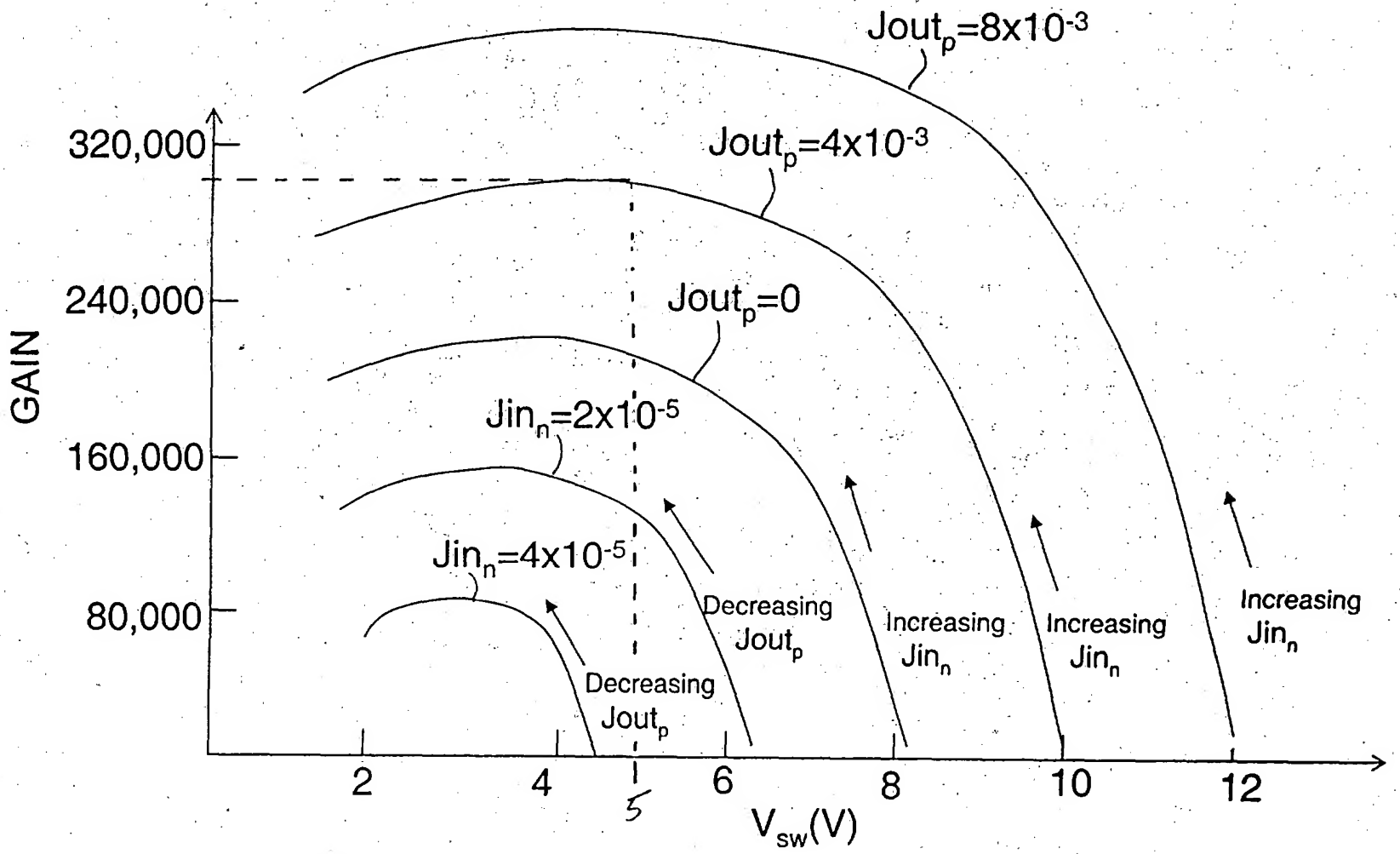

Jout$_p$=8x10^{-3}
Jout$_p$=4x10^{-3}
Jout$_p$=0
Jin$_n$=2x10^{-5}
Jin$_n$=4x10^{-5}
GAIN
320,000
240,000
160,000
80,000
2
4
5
6
8
10
12
V$_{sw}$(V)
Decreasing Jout$_p$
Decreasing Jout$_p$
Increasing Jin$_n$
Increasing Jin$_n$
Increasing Jin$_n$

FIG. 3A3

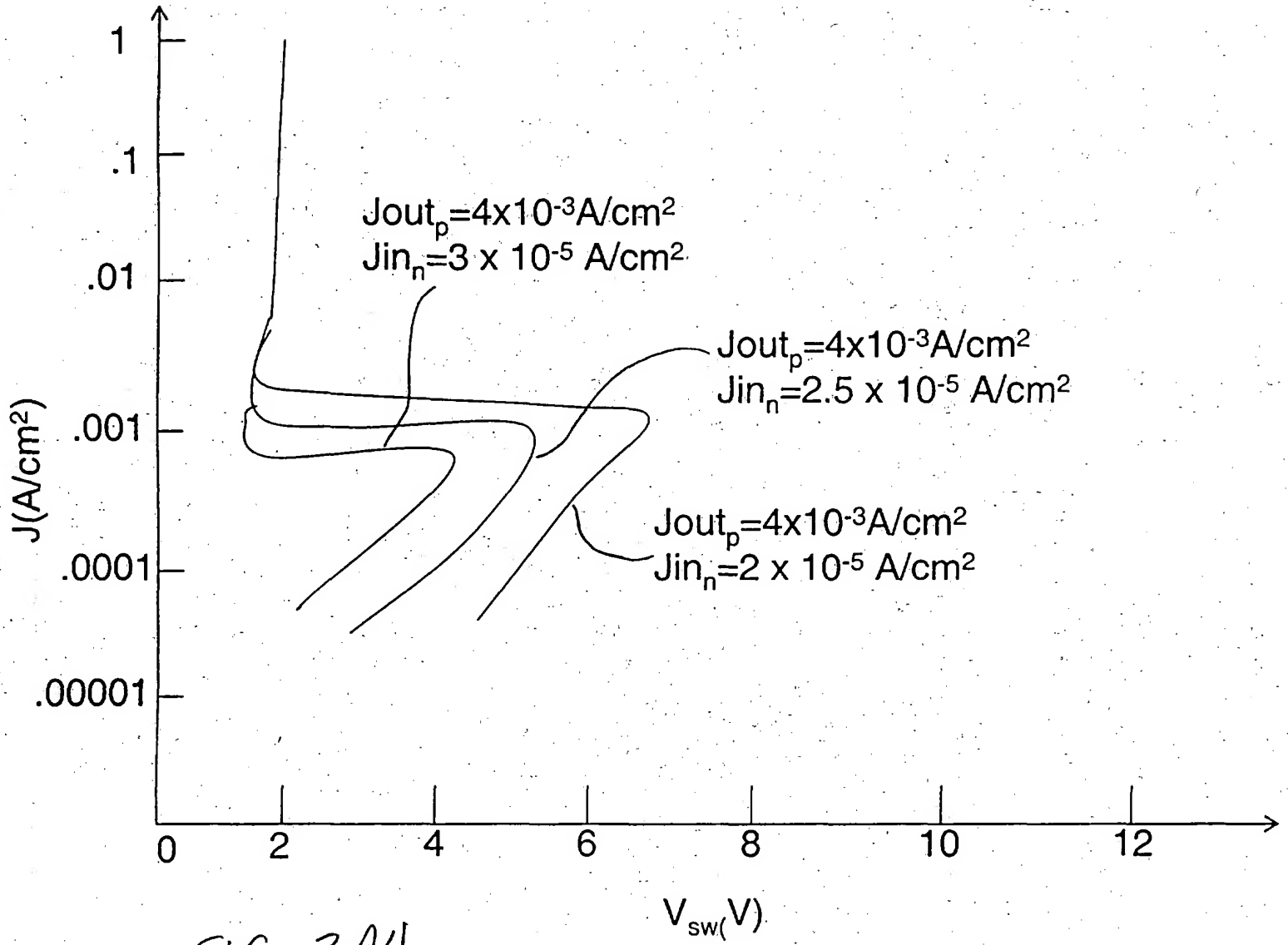

1
.1
.01
.001
.0001
.00001
J(A/cm²)
Jout$_p$=4x10^{-3}A/cm²
Jin$_n$=3 x 10^{-5} A/cm²
Jout$_p$=4x10^{-3}A/cm²
Jin$_n$=2.5 x 10^{-5} A/cm²
Jout$_p$=4x10^{-3}A/cm²
Jin$_n$=2 x 10^{-5} A/cm²
0
2
4
6
8
10
12
V$_{sw}$(V)

FIG. 3A4

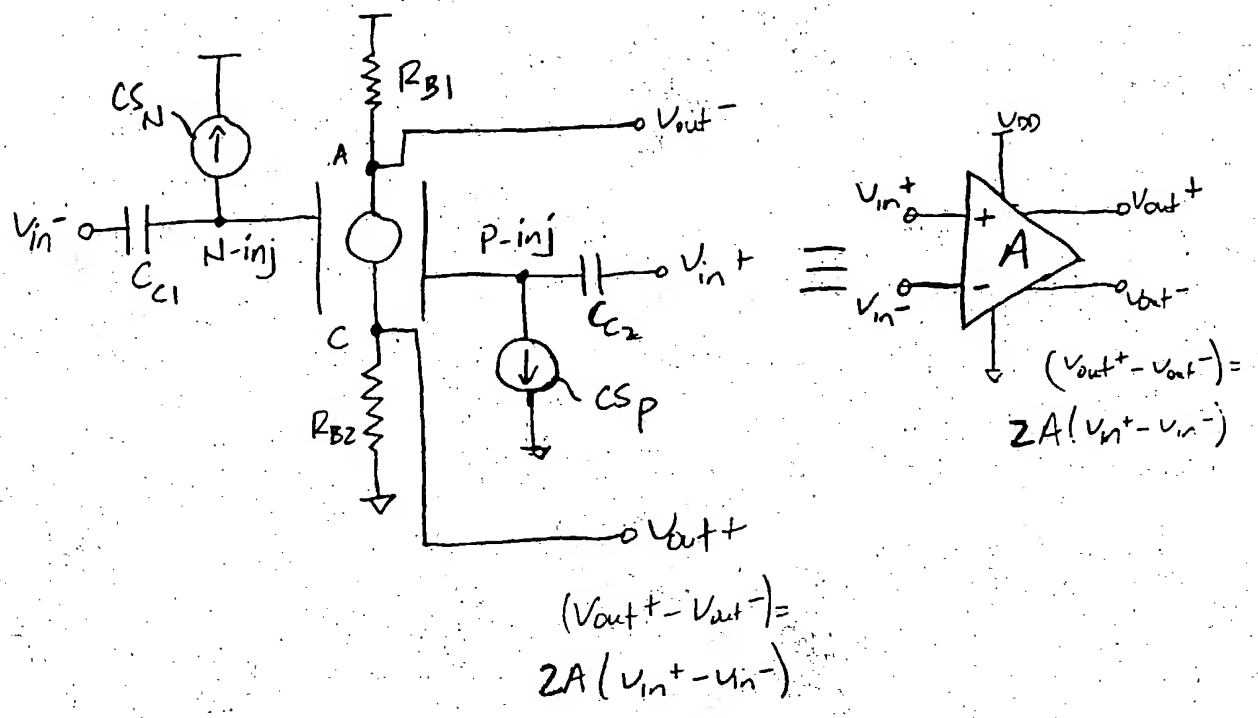

CS_N
R_{B1}
$V_{out}-$
A
$V_{in}-$
C_{C1}
N-inj
P-inj
$V_{in}+$
C_{C2}
C
CS_P
R_{B2}
$V_{out}+$
$(V_{out}+ - V_{out}-) =$
$2A(V_{in}+ - V_{in}-)$
$\equiv$
V_{DD}
$V_{in}+$
$V_{in}-$
A
$V_{out}+$
$V_{out}-$
$(V_{out}+ - V_{out}-) =$
$2A(V_{in}+ - V_{in}-)$

FIG. 3A5

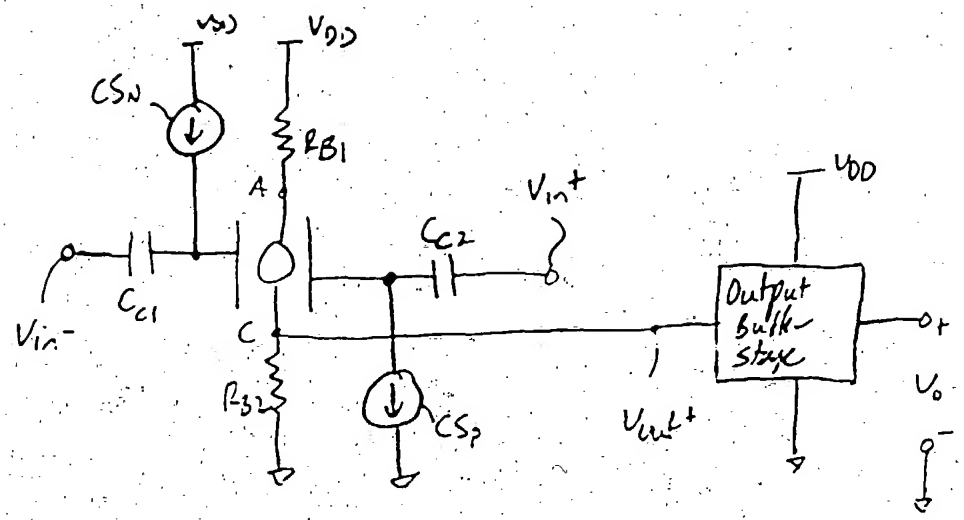
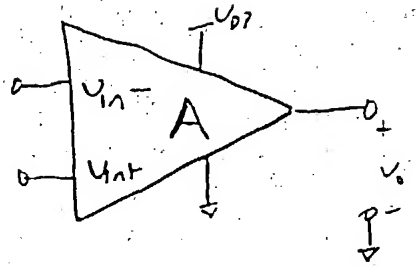
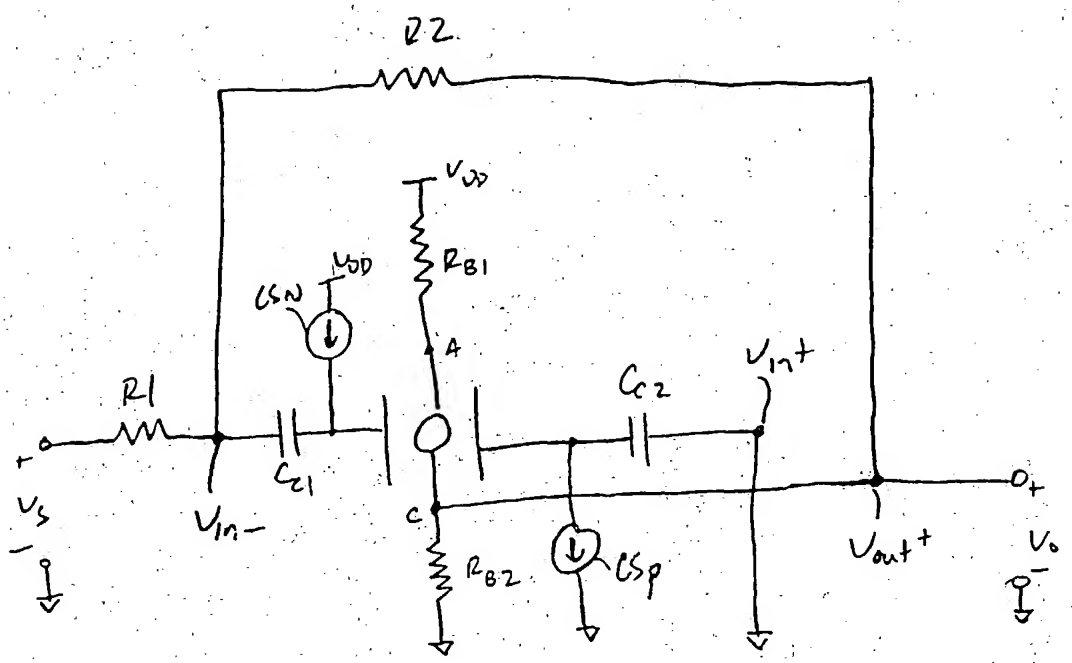


FIG. 3A6 where $V_o \approx -A(V_{in+} - V_{in-})$



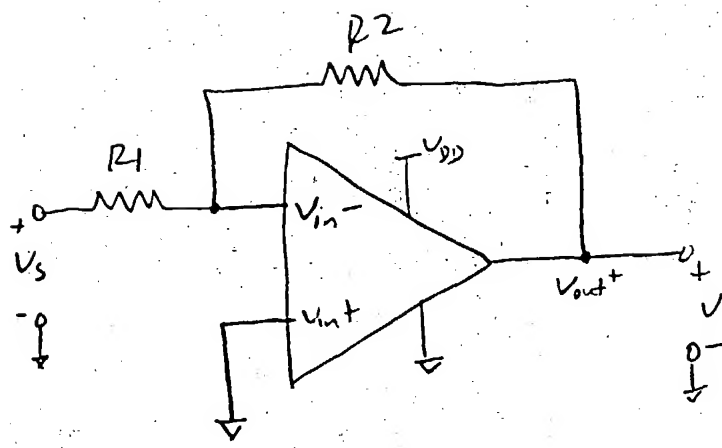
where $V_o \approx -A(V_{in+} - V_{in-})$

FIG. 3A7



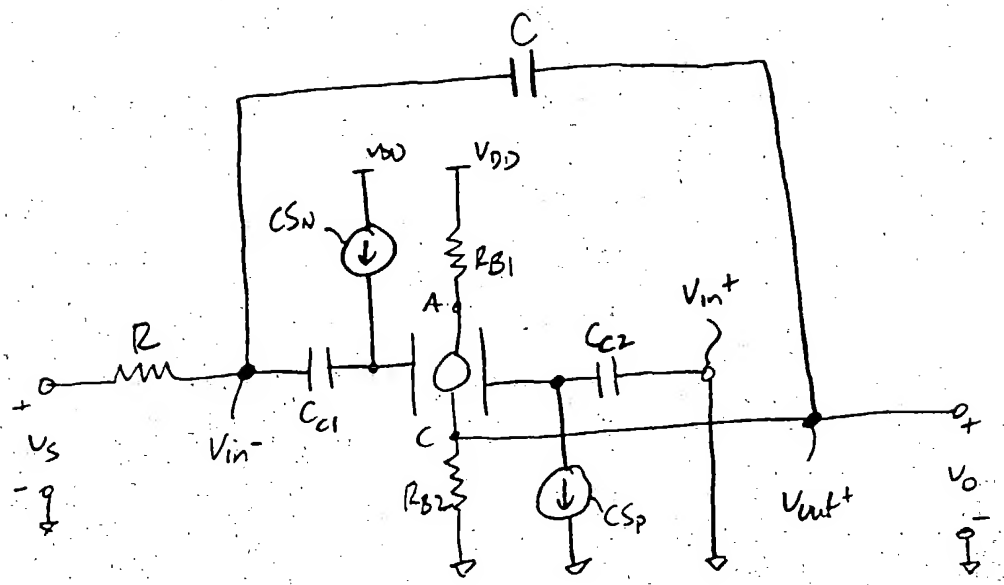
where $V_o \approx -\frac{R_2}{R_1} V_S$

FIG 4A1



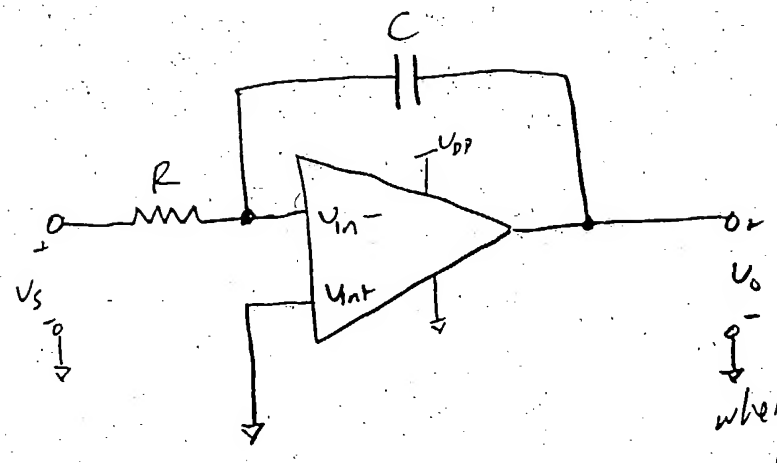
V_o where $V_o \approx -\frac{R_2}{R_1} V_S$

FIG. 4A2



where $v_o(t) \approx \frac{-1}{RC} \int v_s(t)\,dt$

FIG. 4B1



where $v_o(t) \approx \frac{-1}{RC} \int v_s(t)\,dt$

FIG. 4B2